REPORT NO. 83-2-20
ALEXANDRIA FIELD OFFICE

3430
AUGUST 1983

ANNOSUS ROOT ROT PRESENT ON THE RAVEN DISTRICT OF THE SAM HOUSTON NATIONAL FOREST

by

Paul A. Mistretta[1/]

Abstract

Annosus root rot activity was found on six of eight sites visited on the Raven District of the Sam Houston National Forest. Description of hazard rating for annosus root rot is presented, as are management alternatives to prevent or control this disease.

INTRODUCTION

Annosus root rot was found to be active in several stands on the Raven District of the Sam Houston National Forest. This report identifies the soil characteristics which are considered to be high hazard for this disease. Biological and edaphic information is presented to allow foresters to hazard rate sites so as to recommend effective prevention or control measures.

Annosus root rot is a disease of southern yellow pines caused by the fungus Heterobasidion (Fomes) annosum (Fr.) Bref. As its common name implies, this disease results in the degradation of the root systems of infected trees. The root rot that it causes is a stringy white rot; all woody components, including lignin, are decayed. The result of this decay is a root whose structure has been degraded to the point that it no longer functions to conduct water and nutrients or to support the tree.

[1/] Supervisory Pathologist, USDA Forest Service, Southern Region, State and Private Forestry, Forest Pest Management, Alexandria Field Office, Pineville, LA.

Annosus root rot is reported to be most severe in thinned pine plantations established on sites with a high sand content in the soil. Natural stands of pine are not as severely affected by this disease as are planted stands.

Biology of the Disease

Spores (functional equivalents of seeds) of this fungus are produced in a distinctive conk (fruiting body). These conks are normally formed at or about the level of the duff at the base of infected trees or stumps. Spores are airborne and common in areas where the fungus is present.

Spores are deposited on freshly cut stump surfaces. They germinate and the fungus grows throughout the stump and into its root system. Where colonized roots contact or graft with the roots of a live tree, the fungus spreads. As the fungus progressively decays the root system of the tree, the root's ability to transport liquids and nutrients is eroded.

Root systems affected by annosus root rot are readily diagnosed. In the early stages of this disease, roots become pinker than normal and generally show resin soaking. In the intermediate stage of the disease, rot appears as white pockets of decay. Later, as these pockets join together, the roots take on the white, stringy appearance characteristic of this disease.

Crown symptoms begin to appear when nutrients or liquids become limiting to normal growth. Crown symptoms begin as a thinning of the foliage. Less often a yellowing to browning of the remaining needles occurs. Crown decline is progressive, generally resulting in tree death. Root-sprung or wind-thrown trees are commonly seen where this disease is active; top-heavy trees without sufficient numbers of sound roots simply fall over. Any combination of these symptoms can occur in a stand. Dead or declining trees often occur in pockets or centers formed when the disease spreads outward from tree to tree. Pockets can be large and distinct, or they can be small and scattered throughout the stand (giving the appearance of uniform distribution.)

Conks form on stumps or at the base of dying or dead trees. They are often formed below the litter, and, in the South, are most common during the winter months. Sometimes conks are formed on the roots of rootsprung trees.

Southern yellow pines are all susceptible to this disease, however, longleaf pine appears to be somewhat resistant. Loblolly, slash, and shortleaf pines are prime suscepts.

Losses are experienced directly through mortality, however, the undetermined loss of growth by infected trees may be causing a greater loss

(Alexander, Skelley, & Webb, 1981). The latter is a persistent problem throughout the life of the stand.

Soils and Hazard Rating for Annosus Root Rot

A correlation exists between the soil found on a site and the amount of infection and resulting damage to trees susceptible to annosus root rot. Well-drained, deep, sand or sandy-loam soils present the most serious hazard. Deep sandy or sandy-loam soils are described as soils with 12 - 24 or more inches of sand or sandy-loam soil at the surface before reaching any significant clay inclusion. Based on this definition, classification of annosus root rot hazard can be made of soils on a site or on an entire forest.

Hazard rating has absolutely nothing to do with soil fertility. Both very productive and very poor sites can be rated high hazard for annosus root rot. From a silvicultural point of view, recognizing a site as having high hazard for annosus root rot does not eliminate the site from productivity! However, special consideration must be given to the potential for serious disease problems on this site. Several alternatives for prevention or control are outlined later in this paper. These alternatives need to be evaluated in a site specific manner by a qualified prescriptionist and a silviculturist before the final prescription is written for a stand on a high hazard site. Valid reasons may exist for rejecting any or all of these choices, but when prescribing for a high hazard site they should be considered.

"High hazard" has not yet been experimentally quantified. No formulae exist which project volume loss for stands infected with annosus root rot. Loss of volume as a result of reduced growth is currently being investigated. Lacking empirical data, "high hazard sites" are those sites on which we expect a significant amount of infection and damage to the residual stand from annosus root rot after thinning if no preventative strategy is employed.

SURVEY RESULTS

In response to a request from the District Office, a brief survey was made of eight sites on the Raven District, Sam Houston NF, National Forests in Texas. All sites visited were growing primarily shortleaf pine; some had loblolly pine included.

The first area was along the west side of Forest Road 239 extending both before and after the gas wells. It was thinned about 2 years ago. There appeared to be significant thinning of the crowns, a symptom typical of

root rotting activity. Stringy, white rotted roots typical of annosus root rot were found here. Depth of sand was 24 plus inches.

The second site was east of Forest Road 239 on a small lateral road which appeared to be a logging road. Two trees were seen which were showing obvious decline symptoms; one showing flagging was within about 2 ft. of a stump which had been cut within the last 2 to 3 years. While digging to determine soil type, we turned up several rotted roots with the typical symptoms of annosus root rot.

On area three (west side of Forest Road 233 at Gulf States Trade Center) a thinning operation has been performed in the recent past, possibly as recently as within the last 2 years. This site is in very bad shape. The appearance of the residual stand indicates that it was thinned back as much for aesthetic purposes as for timber purposes. A very nice lawn type planting would have been left in this area. Unfortunately, based on crown symptoms, it is very heavily infected with annosus root rot. No sporophores or fruiting-bodies were found at the bases of these trees. Again sand to a depth of 2 plus feet is present here.

In the fourth area (east side of Forest Road 233) a thinning is planned but has not been laid out. This stand shows very few symptoms of root rotting activity. While driving better than a half a mile, only about five trees were seen showing thinned crowns. These trees were not evaluated but suggest the possibility of low level pathological activity, probably root rotting, which should lead to a cautious approach when thinning is undertaken.

The fifth site (north of the "T" in Forest Road 233/233A) is currently being cut. It also does not yet show significant symptoms of root rotting disease. Some of the trees are infected. There were some thin crown trees seen; one directly in front of you as the road T's also has an extremely heavy cone crop which is often indicative of a long term slow root rot activity. This stress crop of cones is normally interpreted as being symptomatic of littleleaf on shortleaf pine, however, it can be symptomatic of any extended slow decline problem. On this site sand to a depth of 1 1/2 ft. or more was the rule. On this site, however, we saw evidence that there was clay at a lower level in the soil profile.

On the sixth site (compartment 68), we saw significant clay inclusion; approximately 12 to 15 inches of fine sand soil overlaid a reddish clay. The clay did not show distinctive signs of mottling common to a poorly-drained littleleaf site. On this site we saw several wind-thrown trees. One tree which had been wind-thrown turned out to be drainage ditch injury which resulted when a drag line was used and cut all the roots on one side of the tree. However, other wind-thrown trees on that particular site showed definite evidence of annosus root rot (whitish, stringy roots which result after the fungus has been active in the stand). A soil sample was taken on this site. There was a possibility that water is being retained on this site and that Phytophthora cinnamomi Rands, the

fungus which causes littleleaf disease, could be present. However, annosus root rot activity appears to be the problem. (Subsequent lab analysis of the soil showed no P. cinnamomi present.)

On the seventh site (compartment 65), we went into an area that appeared to be simple senility; trees 80 plus years old on the site showed thinned crowns. The crown thinning was fairly uniform throughout the section of the stand we were in. These crowns did not have the standard tufted appearance which results from root rot activity. Branch break-outs and discontinous needle distribution (not the shortened and off-color needles common in slow progressive root rot situations), gave the appearance of old age breakup.

At the margin of this site we did encounter some loblolly in a contiguous pocket (not just scattered randomly through the stand but in a cluster in close proximity to each other). These trees show typicial root rot symptoms. This was the only spot where loblolly was observed showing annosus root rot symptoms. Loblolly generally was seen occurring as an incidental within the stand. This fact may account for the observation that in most of these shortleaf stands that were showing severe problems, loblolly did not appear to be affected.

The eighth site (compartment 63) was on a black prairie soil. This was the first soil we had seen all day which could be construed as heavy clay soil. There was some gray mottling of the subsoil here and the clay reached within 6" of the surface. Trees on this site are dated as 1895 making them 88 years old at this time. They were shorter and significantly smaller than I would have expected for 90 year old shortleaf. At one point we did see what appeared to be typical littleleaf symptoms. Since this soil conceivably could support littleleaf, a soil sample was taken. (This composite was analyzed and no P. cinnamomi was present.) No definite evidence of annosus root rot was seen here.

Since annosus root rot is active in six of the eight areas (#'s 1, 2, 3, 4, 5, and 6) we surveyed, prevention and control measures to reduce further spread should be practiced as appropriate. A variety of potential treatments exist for these sites.

As a general rule of thumb, if 50% or more of the stand being evaluated is on a high hazard soil, the prescriptionist should further evaluate preventive or control measures for annosus root rot for that site/stand combination. A more conservative rule would suggest that prevention/control be evaluated if there is any high hazard soil on the site.

Based on this brief survey of sites, it is suggested that a fuller evaluation of the current status of annosus root rot be made on the Raven RD, Sam Houston NF.

PREVENTION AND CONTROL STRATEGIES

Thinning presents the greatest danger of introducing or spreading this disease in a stand. The prescriptionist should recognize this as the best opportunity to prevent entry of the disease into the stand. Several methods are available for preventing or controlling annosus root rot in the forest. Choice of a specific strategy is based on silvicultural, pathological, and economic considerations. Prescriptionists need to tailor the available strategies to fit the site requirements so as to maximize the benefit at each site.

Where disease hazard is low, as a result of site or stand characteristics, no prevention or control measures need to be taken. The recommendation is that these sites be managed without considering disease management strategies aimed at reducing losses to annosus root rot.

For high hazard sites supporting stands not currently infected with annosus root rot, prevention strategies useful on the Sam Houston National Forest include: 1) thinning and treating freshly cut stump surfaces with powdered borax; 2) selectively thinning to favor less susceptible species (hardwoods); 3) shorten rotations to eliminate thinnings as much as possible; 4) thinning during the summer months, when spore production is reduced and stump surface temperatures are high; 5) clearcutting at rotation or prior to prescription date, and regenerating with a less susceptible species, or mix of species; 6) manipulating planting density.

If annosus root rot is already present, reduction of further spread is accomplished by: 7) applying the biological control agent Phlebia (Peniophora) gigantea (Fr.) Donk to freshly cut stump surfaces.

In either high or low hazard situations: 8) prescribed burning within the six months preceding thinning and again soon after will also help to reduce infection.

These alternatives are explained more fully below.

1) Borax (in powdered form) prevents the fungus, H. annosum, from successfully colonizing the surface of the stump. This chemical can be easily sprinkled onto the stump by the sawyer or one of the logging crew. The entire protective operation rarely requires more than 15 seconds per stump to complete. A computer program is available through Forest Pest Management to evaluate cost versus benefit. We must emphasize that borax be used only on stumps of trees which have not been infected by annosus root rot. Borax prevents fungal entry through stump surfaces; use of it on the stump surface of an already infected tree prevents the entry of competitive fungi which may later serve to reduce infection by annosus root rot.

2) Selective thinning which favors non-susceptible species (including hardwoods, and mixtures which can include a percentage of susceptible species distributed uniformly throughout the stand) should be encouraged.

3) Thinning is the time of greatest danger for the introduction of annosus root rot into a stand. Shorter rotation should be specified on a high hazard site where possible, so that one or more thinnings can be eliminated from the prescription.

4) Performing thinnings during the summer months takes advantage of high summer temperature which causes reduced conk production by the fungus, and also restricts germination and colonization of stump surfaces by those spores which are available. This treatment is recommended in areas south of 34° north latitude (the entire Raven RD fits this description) for stands currently not infected with annosus root rot.

5) Clearcutting is a management option available in both infected and uninfected stands at any time. By removing all the trees of the stand the danger of infection from annosus will be minimal and no volume loss should be experienced. If clearcutting is selected as an option, consideration must be given to the composition of the subsequent stand. On high hazard sites the choices become more limiting than on low hazard sites.

On high hazard areas, use other species such as longleaf pine, hardwoods, or mixed (hardwood/pine) stands where silviculturally appropriate. Mixed stands reduce the probability of damage from annosus root rot infection occurring at the time of thinning by increasing spacing between the susceptible trees within the stand to the point that root to root contacts are minimized.

Selection and use of non-susceptible species should confer a degree of resistance to the subsequent stand. Depending on the species selected, species manipulation also reduces danger of infection following thinning in the future.

6) If it is determined by the silviculturist that only a susceptible species is appropriate on the given site, planting density can be manipulated at the time of out-planting to reduce the number of thinnings required for good management of the stand. Manipulation of planting density is effective on sites which have previously supported either infected or non-infected stands. If susceptible species must be planted on high hazard sites which supported an infected stand, expect to lose about five percent of the seedlings within the first five years after outplanting.

7) If thinning is to be done on a high hazard site where annosus root rot is already present, further spread of the disease can be reduced through the use of a biological control agent. Phlebia gigantea is a fungus which competes with H. annosum. It grows rapidly and colonizes the stump precluding successful colonization of the stump by annosus root rot.

Phlebia gigantea is applied to the stump surface as a suspension of spores of the fungus in water. The process, as with borax, is very quick.

8) Prescribed burning within the six months preceding thinning, and soon after, will reduce the amount of infection on any site. The availability of spores is reduced by burning up those conks present at the level of the litter in the stand. An obvious additional benefit of this procedure is the removal of the understory vegetation which very often makes a thinning operation difficult.

SUMMARY

Annosus root rot prevention and control measures are suggested for the Sam Houston National Forest. These measures require that the prescriptionist determine the current status of the stand on the site with relation to annosus root rot. On high hazard sites where annosus is not present and a thinning operation is planned, stump treatment using borax should be considered. On high hazard sites where annosus is already present and thinning is planned, the use of the biological control agent P. gigantea should be considered. On all high hazard sites selective thinning to favor non-susceptible species ought to be considered. Prescribed fire during the six months preceding thinning, and soon after, is recommended for use on those sites where annosus is already present, and should be considered on all high hazard sites.

Where clearcutting and regeneration is being proposed for a high hazard site, species manipulation to favor non-susceptible species should be considered.

On low hazard sites no control measures need to be taken to prevent subsequent infection. Where hazard of infection is low, the cost of preventive or control measures is economically unjustifiable.

REFERENCES

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REPORT NO. 83-2-20
ALEXANDRIA FIELD OFFICE

3430
SEPTEMBER 1983

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Prepared by: Paul A. Mistretta
Supervisory Pathologist

Approved by: F. L. Oliveria
for HARVEY V. TOKO
Staff Director
Forest Pest Management

SOUTHERN REGION, STATE AND PRIVATE FORESTRY
USDA, FOREST SERVICE, ATLANTA, GA 30367